Manual of Empirical Psychology, by G. A. LINDNER, translated by Charles DeGarmo, Ph. D. Boston, 1889. pp. 274.

Although the author is still a professor at Prague and sanctioned and prefaced this translation, and although dreams, insanity, mesmerism, the will, ego, senses, etc., etc., are all given paragraphs or chapters, the book bears no trace of anything done in these or any other psychological field for the last twenty-five years. Nothing can be more helpful to teachers than knowledge of the facts and conclusions reached within this most productive period concerning memory, attention, association, habit, senses, muscles and will, psychic time, psychogenesis, the incipient neuroses so common in the school room, the momentous phenomena of adolescence, etc., but from cover to cover there is not a hint of a single one of these things. That a bright American teacher after studying pedagogy two years in Germany should call this little Herbartian primer a "great and good book," shows how far German pedagogues are behind the best in their own land and line, and how grievously American teachers who go abroad to study educational philosophy need competent direction where to go and what and how to study. That Herbartianism, the fundamental conception of which is that all psychic activity consists in working over ideas *(Bearbeitung der Begriffe)* should from its very completeness become so stagnant and barren is one of the ironies of fate. Yet despite its scientific cheapness and obsoleteness, this book will mark a distinct advance for teachers whose only philosophy of education is the current vagaries of Hegel, now so prevalent among them in this country, an advance, to be sure, made in Germany fifty years ago, but not yet very generally bettered by German teachers. The practical applicability of this standpoint and book makes its merit. It should be read and studied by American teachers for its own sake, for whom we trust it will prove a step toward very far better things for them, could the great resources of modern psychology be now made accessible to them.

Zahl und Verteilung der Markhaltigen Fasern im Froschrückenmark. JUSTUS GAULE. Abhandlungen der Mathematisch-physischen Classe der Königl. Sächsischen Gesellschaft der Wissenschaften. Vol. XV, No. IX, pp. 739-780, 10 plates. Leipzig, 1889.

Die Stellung des Forschers gegenüber dem Problem des Lebens. Rede, JUSTUS GAULE. Leipzig, Verlag von Veit & Co., 1887, pp. 24.

Der Oekus der Zellen. JUSTUS GAULE. Beiträge zur Physiologie, Carl Ludwig gewidmet. Published by F. C. W. Vogel. Leipzig, 1887, pp. 133-148.

The first of these papers, a monument to German patience, is the result of most painstaking work extending over a period of five years; and marks an important advance in our knowledge of the fibre relations in the frog's spinal cord. The condensation of the matter to a limit of forty pages, perfectly classified and arranged, together with full illustration by diagrams and plates, from which the paper may almost be read, form most commendable features of the work.

Dr. Gaule has actually counted the medullated fibres in cross sections of the frog's spinal cord at five levels. These levels are designated throughout the paper as 1, 2, 3, 4, 5; and are taken:—1, at junction of cord with medulla; 2, through root of 2d nerve; 3, near origin of 4th nerve; 4, just below that of the 6th nerve; 5, below origin of 9th nerve. As will be remarked the levels occur at the anterior end of the cord, at the middle of the brachial enlargement, at about the point of greatest constriction in the dorsal region, through the middle of the lumbar enlargement, and near the posterior end of the cord. In regard to

methods employed, Erlyki's fluid, twenty-one days in the dark, at 39°, is followed by parafin embedding, making use of xylol instead of turpentine and clove oil. A perfect series is obtained, and this is stained by Weigert's haematoxylin. The counting is done by the aid of an ocular net micrometer; and since the section is too large for a single field, this is supplemented by a very exact micrometer stage. To insure accuracy in counting, the author employs the principle of bilateral symmetry. How well his work meets the requirements of this control is seen from the following figures.

	1. Section between medulla and cord.	2. Through origin of 2d nerve.	3. About 4th nerve.	4. About 6th nerve.	5. Below 9th nerve.
RIGHT.	28429	36707	21579	30141	8296
LEFT.	28245	37992	20246	30917	8017
Giving sum for different levels	56674	74699	41825	61058	16313

We are also favored with the number of fibres occurring in the different columns of the cord, as follows:—

Posterior columns,	R.	4862	8966	6345	13120	3030	6110	3998	7854	1659	3404
	L.	4104		6775		3080		3856		1742	
Anterior columns,	R.	7499	14881	9966	21566	4578	9098	7877	16091	2067	3814
	L.	7382		11600		4520		8214		1747	
Lateral columns,	R.	14701	29887	19131	36592	13134	25345	16478	33853	4354	8596
	L.	15186		17461		12211		17375		4242	
			53734		71278		40553		57798		15811

Comparison is made between the areas of different sections and the number of fibres contained in them, and this yields the interesting result that the brachial and lumbar enlargements are due to an increase of fibres at these points more than to an increase of gray matter.

Perhaps the most remarkabl econclusion which Gaule draws from his enumeration of fibres is a scheme of the arrangement of fibres in the spinal cord; by which, from the number of fibres entering by each of the spinal roots, he can easily compute the number of fibres in a cross section of the cord at any level. The notions underlying this, as we shall see later, are the ideas so characteristic of Gaule's work, the idea of a "*Chemischer Grund*" and that of the "*Oekus der Zellen*"; *i. e.*, of fixed numerical and quantitative relations obtaining throughout the structural as well as the chemical elements of all organisms. "A certain number of cells of one kind call for a perfectly definite and constant number of cells of another kind." Eggs do not divide hap-hazard into two, three, a dozen parts. But each egg segments in a definite and constant way into two, four, eight, sixteen, etc, This relation is said to be lost in the confusion of great numbers; but in general it holds good and can be revealed in any stage of the animal life by the proper methods. Hence a given number of fibres in a nerve root calls for a definite number of fibres in the spinal cord. These cord-fibres may be divided into three classes, designated by *a*, *b*, *c*.

a.—"Long fibres," which connect the central end of root-fibres with the medulla or some other part of the brain.

b.—"Medium fibres," connecting different regions of the cord.

c.—"Short fibres," which connect parts within the same region.

The author bases the theory of his computation upon seven propositions which are in substance as follows:

Prop. 1. Each medullated fibre in the cord is so placed as to function with one fibre of a spinal root.

Prop. 2. The medullated fibres of the cord form the connections of the root-fibres with each other and with the brain.

Prop. 3. We may divide these connections, according as they are made by the above long, medium, or short fibres, *a*, *b*, *c*, into three classes.

Prop. 4. ("Characteristic and peculiar to my theory.") To the central end of each root-fibre is grouped, in the cord, a definite and perfectly constant number of medullated fibres.

Prop. 5. The central ending of the root-fibres and the origin of the cord-fibres belonging to them do not lie far from the entrance of the root into the cord. (Proved by Birge's count of the elements of the anterior roots, and the simplest supposition for those of the posterior.)

Prop. 6. The length of the medullated fibres depends upon the distance apart of the elements which they connect.

Prop. 7. (Upon which his computation immediately depends). The central end of each root-fibre makes:—*A*, *two* connections with long fibres, one on the same, the other on the opposite side: *B*, *one* connection with a medium fibre, which ascends for the lower, and descends for the upper half of the cord; *C*, *eight* connections with short fibres, two which ascend, and two which descend for each half of the cord.

Taking now Birge's count of the root-fibres as the basis of computation, the number of fibres at different levels of the cord as computed and as actually counted, correspond as follows:

	Computed.	Counted.
Section 1	56,000	56,674
" 2	74,000	74,699
" 3	45,500	41,825
" 4	60,500	61,058
" 5	18,000	16,313

Of the forty pages, Dr. Gaule devotes twelve to an elaboration of his "purpose" in this investigation. And we learn from this that he is prompted to the work by the same ideas which animate his "Rede," ("Discourse on Science and the Problem of Life"), and his "Oekus [*οἶκος*, *Haushalt*] der Zellen," (household of the cells.) Hence the reference to these papers. From these we may obtain a key to Gaule's system. I cite them for this purpose and not with a view to giving complete abstracts from them.

In the "Rede" Gaule says in effect: If we knew all the chemical reactions, and all the physical forces which are present in the phenomena of life, we might still be no nearer the solution of the problem. May not life itself lie outside of these things, in groupings or combinations of groups of chemical and physical processes? To quote a few words: "These reflections have cooled the cheerful courage and high hopes of scientists who have turned toward the problem of life. Those who grasped most clearly the greatness of the task, were the first to doubt the possibility of its solution. I do not know what gives me courage to contradict them, but I cannot silence my hope. Let me tell you how I think the difficulties in the problem may be overcome." Innumerable as are the forms of living beings, certain common limits teach us that the processes throughout are in main features the same. And Hoppe-Seyler has already reached a general characteristic of all the processes taking place in living beings.

With the same chemical basis, why then, are not all living beings alike? Why are not all molecules which contain oxygen, hydrogen, and carbon, alike? Because different *processes* result in different combinations, different compounds, *i. e.*, different structural arrangements of the atoms.

These, which we may call higher combinations, make possible higher processes, to form in turn still higher combinations, and so on. As in terms of biology different physiological processes produce different morphological structures, vice versa, more highly developed structures cause, in a sense, higher physiological actions. These chemical processes must be in nature "cyclical," catalytic, resembling the action of ferments.

As Gaule expresses it at the close of the "Rede": "Life is cyclical, thus cause and effect must change about in it. As force is the cause of form so form is also the cause of force."

In the "Oekus" we find the thought developed a step further. He uses the word "Oekus" to designate an ideal organism in which the structures, organs, mediating these cyclical changes are linked in an unbroken chain. In imagination it is possible to trace, we will say, a molecule of food through each organ from one end of the chain to the other. The first organ receives it, makes use of it for its own life and excretes it, when of no further use to itself, in the form required by the next organ; and so on through the whole chain. This he attempts to illustrate in the organization of a frog and in certain cyclical changes which he has observed to take place in the formation of the blood. "The case is further complicated," he adds, "by the fact that every cell, while a part of the œkus, is after a fashion an œkus in itself."

The next step in the development of the thought we find expressed under the head of "Purpose," in the article first reviewed. It is the necessary logical consequent of what precedes in the "Rede" and "Oekus." "I make bold to assert," he says, "that the [numerical] relations obtaining between these elements, [of nerve, muscle, gland, etc.,] characterize absolutely genera and species." The purpose of my work is to supply a small link in the chain of evidence necessary to demonstrate this fact.

It is difficult to pass judgment upon the theoretical portion of Gaule's work. At present it seems to rest more upon analogy than upon fact. On the one side, the definite constitution of the chemical molecule he projects by analogy into the organization of living matter. On the other side, from the economy of the household he draws by analogy mutual relationship between the cells or lower elements of living matter. He cannot expect all to follow him on ground of analogy. Still Dr. Gaule has faced the problem of life in a manner which calls for no prejudice. It is true his "*Würmchen*" was ridiculed as a parasite of the blood. So persecuted they the spermatozoön and the white blood corpuscle before it. Prejudice and dogmatism may say what they please about such work. It makes little difference. The problem of life is too deep for either of them to solve. And it is quite possible, if we are ever to approach its solution, that we may be compelled to adopt new ideas of organization. No doubt, however, can arise as to the value of the practical portions of his work.

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